REMARKS/ARGUMENTS

The present Amendment is in response to the Office Action having a mailing date of October 24, 2006. Claims 1-39 are pending in the present Application. Applicant has amended claims 9, 10, 21, 22, 33, and 34. Applicant has also canceled claims 38-39 and added claim 40. Consequently, claims 1-37 and 40 remain pending in the present Application.

Applicant has amended claims Applicant has amended claims 9, 10, 21, 22, 33, and 34 to be in independent form, incorporating the limitations of the base claim and any intervening claims. Applicant has also added new claim 43. Support for new claim 43 may be found in the specification, paragraph 24 and FIG. 1. Accordingly, Applicant respectfully submits that no new matter is added.

In the above-identified Office Action, the Examiner indicated that claims 9, 10, 21, 22, 33, and 34 would be allowable if rewritten or amended to be in independent form, incorporating the limitations of the base claim and any intervening claims.

Applicant welcomes the Examiner's indication that claims 9, 10, 21, 22, 33, and 34 contain allowable subject matter. Applicant has amended claims 9, 10, 21, 22, 33, and 34 to be in independent form, incorporating the limitations of the base claim and any intervening claims. Accordingly, Applicant respectfully submits that claims 9, 10, 21, 22, 33, and 34 are allowable as currently presented.

In the above-identified Office Action, the Examiner objected to FIG. 3 because the numbers for the abscissa of the plot were overlapped by the text. Applicant has provided herewith a replacement drawing sheet in which the numbers for the abscissa do not overlap the text. Accordingly, Applicant respectfully submits that the Examiner's objections to FIG. 3 have been addressed.

In the above-identified Office Action, the Examiner indicated that claims 39 and 38 would be objected to on double patenting grounds if claims 25 and 37, respectively, became allowable.

Applicant has canceled claims 38-39. Accordingly, Applicant respectfully submits that the above objections are moot.

In the above-identified Office Action, the Examiner rejected claims 1-8, 11-20, 23-32, and 35-39 under 35 U.S.C. § 102 or, in the alternative, 35 U.S.C. § 103 as being unpatentable over U.S. Patent Publication No. 20030030947 (Ooshima). In particular, the Examiner stated:

> **Ooshima are silent regarding whether the junction has a slope of less than forty-five degrees when measured at a location seven nanometers below a top of the cap layer; however, as the figures of Ooshima are not indicated as being to scale, it is possible that the apparatus disclosed by Ooshima meets the claimed dimensional limitations.**
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> **Even if the apparatus disclosed by Ooshima did not meet the claimed dimensional limitations, it would have been obvious to arrive at the claimed dimensions through the process of routine experimentation and optimization in the absence of criticality.**

The Examiner made analogous arguments for the limitation in claims 13 and 37 that the second distance which the magnetically soft layer extends in the track width direction is less than have the first distance which the antiferromagnetic layer extends in the track width direction. Similarly, the Examiner made analogous arguments for the limitation in claim 25 that the stack formed by the antiferromagnetic ferromagnetic and magnetically soft layers has a thickness that is less than the amount that the antiferromagnetic layer extends beyond the end of the magnetically soft layer in the track-width direction.

Applicant respectfully disagrees with the Examiner's rejection. Claim 1 recites a magnetic sensor including an antiferromagnetic layer, a ferromagnetic layer, a magnetically soft layer, a cap layer, and an underlayer. The ferromagnetic layer is disposed over the antiferromagnetic layer, has a magnetization that remains substantially fixed in response to an applied magnetic field and extends in the track-width direction to terminate in a first end. The magnetically soft layer is

disposed over the ferromagnetic layer, has a magnetization that rotates in response to the applied magnetic field, and extends in the track-width direction to terminate in a second end. The first and second ends form part of a junction. The cap layer is disposed over the magnetically soft layer such that the junction has a slope of less than forty-five degrees when measured at a location seven nanometers below a top of the cap layer. The magnetically hard layer is disposed adjacent to at least the second end, has a magnetization that remains substantially fixed in response to the applied magnetic field, and stabilizes the magnetization of the end of the magnetically soft layer. The underlayer is disposed between the antiferromagnetic layer and the magnetically hard layer.

Thus, the magnetic sensor includes a junction formed at the ends of the magnetically soft (e.g. free) and ferromagnetic (e.g. pinned) layers. This junction has a specific slope (less than forty-five degrees) at a specific location (seven nanometers below the cap layer top). Furthermore, the use of the junction having such a slope, particularly in combination with a thicker underlayer, provides specific benefits performance. In particular, the resultant is that the magnetically hard layer is better aligned with the magnetically soft layer, resulting in reduced noise, reduced asymmetry and a reduced shield-to-shield spacing. Specification, paragraphs 22, 24, 36, 37.

With respect to the rejection under 35 U.S.C. 102, Applicant notes that "for anticipation under 35 U.S.C. 102, the reference must teach every aspect of the invention either explicitly or impliedly. Any feature not directly taught must be inherently present." MPEP 706.602(a)(IV). With respect to the Examiner's rejection under 35 U.S.C. 103, Applicant notes that "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination". MPEP 2143.01(III). Thus, the mere possibility that a magnetic sensor might be designed with the recited limitations is

insufficient. There must be some teaching or suggestion in Ooshima or the related art of the claimed element or to make an appropriate modification to Ooshima.

Ooshima fails to teach or suggest the combination of elements in the magnetic sensor of claim 1, particularly including the angle range for the junction at the specific location recited. Ooshima describes magnetic sensors which are generally trapezoidal in shape. Both the prior art magnetic sensor described in Ooshima and the magnetic sensors in accordance with the teachings of Ooshima are apparently trapezoidal. Ooshima, Abstract; FIG. 1 and paragraph 91 (Ooshima's invention); FIG. 16 and paragraph 6 (Ooshima's prior art). In order to achieve Ooshima's objects of the invention, Ooshima forms the underlayer at a particular elevation: "halfway of the level of the inclined face of the resistive multilayer[, which is the combination of the antiferromagnetic layer, pinned layer, nonmagnetic conductive layer, and free layer]. [Consequently, t]he entire bottom face of the hard bias layer is in contact with the bias underlayer, and the hard bias layer is formed on the bias underlayer by being lifted to be flush with the free magnetic layer." Ooshima, paragraph 28. See also, paragraph 115. Ooshima, therefore, teaches a specific configuration having to do with the relative heights of the underlayer for the hard bias layer and the combination of the free and pinned layers.

Ooshima fails to teach or suggest the magnetic sensor recited in claim 1. As the Examiner has acknowledged, Ooshima fails to specifically describe a junction having a slope of less than forty-five degrees at a location seven nanometers below a top of the cap layer. Moreover, Ooshima provides specific teachings with respect to the dimensions and orientations of the layers in the magnetic sensor of Ooshima. Both the prior art sensor described in Ooshima and the magnetic sensor of Ooshima are trapezoidal in nature. A distinguishing feature of the magnetic sensor of Ooshima is apparently that the bias underlayer of Ooshima is formed halfway up the magnetic

sensor such that the bias layer is lifted to the level of the free layer. Ooshima, Abstract and paragraphs 28 and 115. Thus, Ooshima is not concerned with the slope of the junction at any location. Instead, Ooshima is concerned with the heights, or thicknesses, of the bias underlayer with respect to the pinned, free, and antiferromagnetic layers. Thus, the recited slope at the recited location is not only not explicitly present in Ooshima, it is also not inherently present. Ooshima also provides a specific mechanism for achieving the benefits of Ooshima, the relative heights of the bias underlayer and free layer. Consequently, Ooshima does not suggest a specific range of angles for the slope of the junction at recited location. Ooshima fails thus to teach or suggest the magnetic sensor recited in claim 1.

Furthermore, "Applicants can rebut a *prima facie* case of obviousness based on overlapping ranges by showing the criticality of the claimed range." MPEP 2144.05(III). In addition, the Examiner noted that "it would have been obvious to arrive at the claimed dimensions through the process of routine experimentation and optimization **in the absence of criticality**." (Emphasis added). Ooshima teaches no range of angles for the slope at such a location other than to indicate that the magnetic sensor is "trapezoidal" in nature. Ooshima, Abstract. Further, Applicant can find no indication in Ooshima that the slope of the junction, as opposed to relative heights of layers, is of interest. In contrast, as discussed in the specification, a magnetic element having a slope at the recited location in the recited range may have improved noise, improved symmetry, and a reduced shield-to-shield spacing. Without such a slope, the relative positions of the layers of the recited magnetic sensor and the attendant benefits may not be achieved. Consequently, Applicant respectfully submits that, at least in some embodiments, such an angle range meets the criticality requirement. Accordingly, Ooshima fails to teach or suggest the recited junction having a slope of less than forty-five degrees at a location seven nanometers below the top of the cap layer.

Applicant also respectfully submits that any conclusion that Ooshima teaches or suggests the recited combination of elements for the magnetic sensor involves improper hindsight. This is particularly true in light of the Examiner's indication that it would be "possible" to achieve the structure and that the recited dimensions would have been arrived at through routine experimentation and optimization. Applicant respectfully submits that such a conclusion is also based on an obvious to try reasoning. In particular, Applicant notes that

> '[t]he admonition that 'obvious to try' is not the standard under § 103 has been directly mainly at two kinds of error. In some cases, what would have been 'obvious to try' would have been to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art **gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful** . . .' *In re O'Farrell*, 853 F.2d 894,903, 7USPQ2d 1673, 1681 (Fed. Cir. 1988) (citations omitted). . ."

MPEP 2145(B) (Emphasis added.).

Applicant has found no indication in Ooshima that the *slope* of the junction is critical to the success of the magnetic sensor of Ooshima. Other than indicating that the magnetic sensor is trapezoidal, and thus has a junction having a slope between zero and ninety degrees, Ooshima gives no indication as to what the slope's angle might or should be. Thus, there is also no indication in Ooshima which angle, of a multitude that might be chosen, should be selected. Furthermore, there is no indication in Ooshima where this slope can or should be measured. Consequently, Applicant respectfully submits that the conclusion that Ooshima teaches or suggests the recited magnetic sensor including a junction having an angle of less than forty-five degrees at a location seven nanometers below the top of the cap layer is based on improper hindsight and obvious to try reasoning. Accordingly, Applicant respectfully submits that claim 1 is allowable over the cited references.

Ooshima also fails to teach or suggest the magnetic sensor recited in claims 13 and 27. Claim 13 recites a magnetic element having an antiferromagnetic layer, a ferromagnetic layer, and a magnetically soft layer. Claim 13 recites that the antiferromagnetic layer extends a first distance in a track-width direction and that the magnetically soft layer extends a second distance in the track-width direction. In addition, the second distance is not more than half the first distance. Claim 37 has an analogous recitation of the first and second distances.

Ooshima fails to teach or suggest a magnetic sensor having the recited combination of elements, particularly in which the second distance that the magnetically soft layer extends in the track-width direction is not more than half of the first distance that the antiferromagnetic layer extends in the track width direction. As discussed above, the mere possibility that a magnetic sensor might be designed with the recited limitations is insufficient. There must be some teaching or suggestion in Ooshima or the related art of the claimed element or to make an appropriate modification to Ooshima.

As the Examiner has acknowledged, Ooshima is silent as to the second distance being not more than half the first distance. Moreover, the magnetic sensor of Ooshima has specific relative heights of the underlayer, bias layer, and combination of the free, conductive, pinned, and antiferromagnetic layers. These heights are perpendicular to the track width direction. Other than an indication that the magnetic sensors of Ooshima are "trapezoidal" in nature, Applicant has found no mention in Ooshima of desired limitations of lengths of the free and antiferromagnetic layers. Consequently, Ooshima does not teach or suggest the second distance being not more than half the first distance. Ooshima fails thus to teach or suggest the magnetic sensor recited in claims 13 and 37.

Applicant also respectfully submits that any conclusion that Ooshima teaches or suggests the recited combination of elements for the magnetic sensor of claims 13 and 37 involves improper hindsight. This is particularly true in light of the Examiner's indication that it would be "possible" to achieve the structure and that the recited dimensions would have been arrived at through routine experimentation and optimization. Applicant respectfully submits that such a conclusion is also based on an obvious to try reasoning. Applicant has found no indication in Ooshima that the *length* of any layer is important to the success of the magnetic sensor of Ooshima. Other than indicating that the magnetic sensor is trapezoidal, Ooshima gives no indication as to what the relative lengths of the antiferromagnetic and magnetically soft layers might or should be. Thus, there is also no indication in Ooshima which relationship between the lengths, out of a multitude that might be chosen, should be selected. Consequently, Applicant respectfully submits that the conclusion that Ooshima teaches or suggests the recited magnetic sensor including a magnetically soft layer extending in a track width direction not more than have the distance that the antiferromagnetic layer extends in the track width direction is based on improper hindsight and obvious to try reasoning. Accordingly, Applicant respectfully submits that claims 13 and 37 are allowable over the cited references.

Ooshima also fails to teach or suggest the magnetic sensor recited in claim 25. Claim 25 recites a magnetic element having an antiferromagnetic layer, a ferromagnetic layer, and a magnetically soft layer that terminates in an end. Claim 25 further recites that the antiferromagnetic layer, ferromagnetic layer and magnetically soft layer form a stack having a thickness that is less than an amount that the antiferromagnetic layer extends in the track-width direction beyond the end.

Ooshima fails to teach or suggest a magnetic sensor having the recited combination of elements, particularly in which the stack has a thickness that is less than an amount that the antiferromagnetic layer extends in the track-width direction beyond the end of the magnetically soft layer. As discussed above, the mere possibility that a magnetic sensor might be designed with the recited limitations is insufficient. There must be some teaching or suggestion in Ooshima or the related art of the claimed element or to make an appropriate modification to Ooshima.

As the Examiner has acknowledged, Ooshima is silent as to the stack having a thickness that is less than an amount that the antiferromagnetic layer extends in the track-width direction beyond the end of the magnetically soft layer. Moreover, the magnetic sensor of Ooshima has specific height of the underlayer and hard bias layer with respect to the height combination of the free, conductive, pinned, and antiferromagnetic layers. These heights are perpendicular to the track width direction. Despite specific criteria for these heights, Applicant has found no mention in Ooshima of a desired relationship between the height of the stack and amount by which the antiferromagnetic layer extends beyond the magnetically soft layer's end in a perpendicular (the track-width) direction. Consequently, Ooshima does not teach or suggest the stack has a thickness that is less than an amount that the antiferromagnetic layer extends in the track-width direction beyond the end of the magnetically soft layer. Ooshima fails thus to teach or suggest the magnetic sensor recited in claim 25.

Applicant also respectfully submits that any conclusion that Ooshima teaches or suggests the recited combination of elements for the magnetic sensor of claim 25 involves improper hindsight. This is particularly true in light of the Examiner's assertion that it would be "possible" to achieve the structure and that the recited dimensions would have been arrived at through routine experimentation and optimization. Applicant respectfully submits that such a conclusion is also

based on an obvious to try reasoning. Applicant has found no indication in Ooshima that the *length* any layer extends beyond the end of the magnetically soft layer relative to the height of the stack is relevant to the success of the magnetic sensor of Ooshima. Thus, there is also no indication in Ooshima which relationship between the lengths and heights, out of a multitude that might be chosen, should be selected. Consequently, Applicant respectfully submits that the conclusion that Ooshima teaches or suggests the recited magnetic sensor including a stack having a thickness that is less than an amount that the antiferromagnetic layer extends in the track-width direction beyond the end of the magnetically soft layer is based on improper hindsight and obvious to try reasoning. Accordingly, Applicant respectfully submits that claim 25 is allowable over the cited references.

Claims 2-12, 14-24, and 26-36 depend upon independent claims 1, 13, and 25, respectively. Consequently, the arguments herein apply with full force to claims 2-12, 14-24, and 26-36. Accordingly, Applicant respectfully submits that claims 2-12, 14-24, and 26-36 are allowable over the cited references.

Furthermore, Applicant respectfully submits that claims 2-3, 7, 12, 15, 19, 24, 27, 31, and 36 are separately allowable over the cited references. Claims 2-3, 15, and 27 recite the relative thicknesses of the underlayer and the magnetically hard layer. Claims 7, 19, and 31 recite relative thicknesses for the junction and the combination of the underlayer and the magnetically hard layer. Claims 12, 24, and 36 recite specific read gap thicknesses. Applicant has found no mention in Ooshima of the recited thicknesses in Ooshima. Consequently, an analysis that is analogous to the discussion above with respect to Ooshima applies to claims 2-3, 7, 12, 15, 19, 24, 27, 31, and 36. Further, Applicant respectfully submits that a conclusion that Ooshima teaches or suggests the magnetic sensors recited in claims 2-3, 7, 12, 15, 19, 24, 27, 31, and 36 involves improper

hindsight. Accordingly, Applicant respectfully submits that claims 2-3, 7, 12, 15, 19, 24, 27, 31, and 36 are separately allowable over the cited references.

New claim 40 recites a magnetic sensor including an antiferromagnetic layer, a ferromagnetic layer, a magnetically soft layer, a magnetically hard layer, and an underlayer. Claim 40 further recites that the ends of the magnetically soft and ferromagnetic layers form a junction. In addition, as recited in claim 40, the junction has a slope of at least twenty and not more than forty degrees at the magnetically soft layer.

Ooshima fails to teach or suggest the magnetic sensor recited in claim 40. Claim 40 recites a magnetic sensor including a junction that, in terms of the range of angles, has a slope that is analogous to the magnetic sensor recited in claim 1. Consequently, the arguments above with respect to claim 1 apply to the claim 40. Accordingly, Applicant respectfully submits that claim 40 is allowable over the cited references.

Applicant's attorney believes that this application is in condition for allowance. Should any unresolved issues remain, Examiner is invited to call Applicant's attorney at the telephone number indicated below.

Respectfully submitted,

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